

Content Covered by the ACT Mathematics Test

Six content areas are included in the Mathematics Test: pre-algebra, elementary algebra, intermediate algebra, coordinate geometry, plane geometry, and trigonometry. The questions covering pre-algebra and elementary algebra make up the Pre-Algebra/Elementary Algebra subscore. The questions covering intermediate algebra and coordinate geometry make up the Intermediate Algebra/Coordinate Geometry subscore. The questions covering plane geometry and trigonometry make up the Plane Geometry/Trigonometry subscore. A brief description and the approximate percentage of the test devoted to each content area are given below.

PRE-ALGEBRA/ELEMENTARY ALGEBRA

Pre-Algebra (23%). Questions in this content area are based on basic operations using whole numbers, decimals, fractions, and integers; place value; square roots and approximations; the concept of exponents; scientific notation; factors; ratio, proportion, and percent; linear equations in one variable; absolute value and ordering numbers by value; elementary counting techniques and simple probability; data collection, representation, and interpretation; and understanding simple descriptive statistics.

Elementary Algebra (17%). Questions in this content area are based on properties of exponents and square roots, evaluation of algebraic expressions through substitution, using variables to express functional relationships, understanding algebraic operations, and the solution of quadratic equations by factoring.

INTERMEDIATE ALGEBRA/COORDINATE GEOMETRY

Intermediate Algebra (15%). Questions in this content area are based on an understanding of the quadratic formula, rational and radical expressions, absolute value equations and inequalities, sequences and patterns, systems of equations, quadratic inequalities, functions, modeling, matrices, roots of polynomials, and complex numbers.

Coordinate Geometry (15%). Questions in this content area are based on graphing and the relations between equations and graphs, including points, lines, polynomials, circles, and other curves; graphing inequalities; slope; parallel and perpendicular lines; distance; midpoints; and conics.

PLANE GEOMETRY/TRIGONOMETRY

Plane Geometry (23%). Questions in this content area are based on the properties and relations of plane figures, including angles and relations among perpendicular and parallel lines; properties of circles, triangles, rectangles, parallelograms, and trapezoids; transformations; the concept of proof and proof techniques; volume; and applications of geometry to three dimensions.

Trigonometry (7%). Questions in this content area are based on understanding trigonometric relations in right triangles; values and properties of trigonometric functions; graphing trigonometric functions; modeling using trigonometric functions; use of trigonometric identities; and solving trigonometric equations.

TIPS: <http://www.actstudent.org/testprep/tips/index.html>

Practice test:

<http://www.act.org/aap/pdf/preparing.pdf>

http://www.actstudent.org/sampletest/math/math_01.html

Extra tests
I have included a
practice test
Remember to practice
strategies

Basics Drill

1. Which of the following expresses the prime factorization of 54?

A. 9×6
 B. $3 \times 3 \times 6$
 C. $3 \times 3 \times 2$
 D. $3 \times 3 \times 3 \times 2$
 E. 5.4×10

2. $\frac{(-5)(4)|-6|}{-3} =$

F. -120
 G. -40
 H. 40
 J. 60
 K. 120

3. The number 1,134 is divisible by all of the following except

A. 3
 B. 6
 C. 9
 D. 12
 E. 14

4. $(-2)^3 + (3)^{-2} + \frac{8}{9} =$

F. -7
 G. $-1\frac{7}{9}$
 H. $\frac{8}{9}$
 J. $1\frac{7}{9}$
 K. 12

5. $27^{\frac{2}{3}}$

A. -9
 B. -4
 C. 9
 D. 18
 E. 81^3

6. For all $x \neq 0$, $y \neq 0$, $\frac{(xy)^3 z^0}{x^3 y^4} =$

F. $\frac{1}{y}$
 G. $\frac{z}{y}$
 H. z
 J. xy
 K. xyz

7. When is $\frac{11-a}{2}$ an integer?

A. Only when a is negative
 B. Only when a is positive
 C. Only when a is odd
 D. Only when a equals 0
 E. Only when a is even

8. How many even integers are there between -4 and 4?

F. 1
 G. 3
 H. 4
 J. 5
 K. 7

9. If the four-digit number 47W6 is divisible by 6 (W represents the tens digit), which of the following could be the value of W?

A. 2
 B. 3
 C. 4
 D. 6
 E. 8

10. If $9^x = \frac{1}{3}$, then $x =$

F. -3
 G. -2
 H. -1
 J. $-\frac{1}{2}$
 K. $-\frac{1}{3}$

Arithmetic Drill

The ratio of boys to girls at the Milwood School is 4 to 5. If there are a total of 27 children at the school, how many boys attend the Milwood School?

- A. 4
- B. 9
- C. 12
- D. 14
- E. 17

2. Linda computed the average of her six biology test scores by mistakenly adding the totals of five scores and dividing by five, giving her an average score of 88. When Linda realized her error, she recalculated and included the sixth test score of 82. What is the average of Linda's six biology tests?

- F. 82
- G. 85
- H. 86
- J. 87
- K. 88

3. In the process of milling grain, 3% of the original is lost because of spillage, and another 5% of the original is lost because of mildew. If the mill starts out with 490 tons of grain, how much (in tons) remains to be sold after milling?

- A. 425
- B. 426
- C. 420.5
- D. 440
- E. 450.8

4. $5\frac{1}{3} - 6\frac{1}{4} = ?$

F. $\frac{-11}{12}$

G. $\frac{-1}{2}$

H. $\frac{-2}{7}$

J. $\frac{1}{2}$

K. $\frac{9}{12}$

5. $1,245 \div .05 = ?$

A. 200

B. 2,490

C. 2,500

D. 24,900

E. 25,000

Algebra Drill

1. If $x = -3$, then $\frac{(x+3)(x-3)}{9} = ?$

- A. 0
- B. 1
- C. 3
- D. 5
- E. 6

2. What is the largest value of x that solves the equation $x^2 - 4x + 3 = 0$?

- F. 1
- G. 2
- H. 3
- J. 4
- K. 5

3. If $x + 2y = 8$ and $\frac{x}{2} - y = 10$, then $x = ?$

- A. -7
- B. 0
- C. 10
- D. 14
- E. 28

4. For all $x \neq -9$, $\frac{x^2 + 6x - 27}{(x + 9)} = ?$

- F. $x + 9$
- G. $x - 3$
- H. $x + 3$
- J. $2x - 4$
- K. $2x + 3$

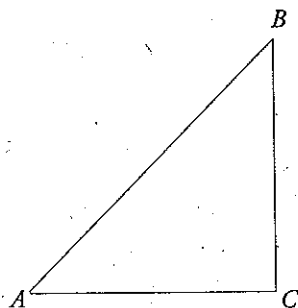
5. If 2 less than 3 times a certain number is the same as 4 more than the product of 5 and 3, what is the number?

- A. 7
- B. 10
- C. 11
- D. 14
- E. 15

6. A certain number of books are to be given away at a promotion. If $\frac{2}{5}$ of the books are distributed in the morning and $\frac{1}{3}$ of the remaining books are distributed in the afternoon, what fraction of the books remains to be distributed the next day?

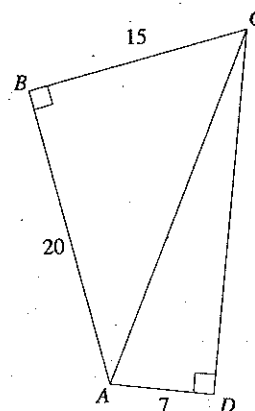
- F. $\frac{1}{5}$
- G. $\frac{2}{5}$
- H. $\frac{1}{3}$
- J. $\frac{5}{7}$
- K. $\frac{8}{9}$

Geometry Drill



1. In $\triangle ABC$ above, $\angle A = \angle B$, and $\angle C$ is twice the measure of $\angle B$. What is the measure, in degrees, of $\angle A$?

A. 30
B. 45
C. 50
D. 75
E. 90

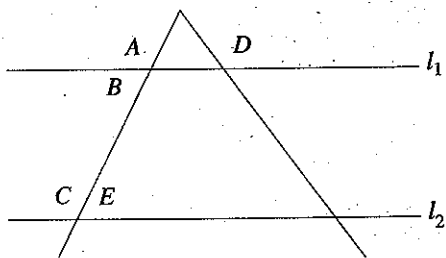


3. In the figure above, right triangles ABC and ACD are drawn as shown. If $\overline{AB} = 20$, $\overline{BC} = 15$, and $\overline{AD} = 7$, then $\overline{CD} = ?$

A. 21
B. 22
C. 23
D. 24
E. 25

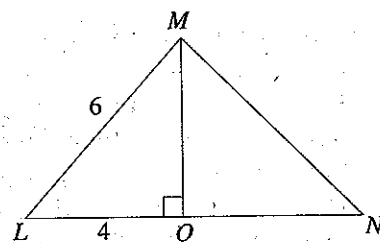
4. If the area of circle A is 16π , then what is the circumference of circle B if its radius is $\frac{1}{2}$ that of circle A ?

F. 2π
G. 4π
H. 6π
J. 8π
K. 16π



2. In the figure above, $l_1 \parallel l_2$. Which of the labeled angles must be equal to each other?

F. A and C
G. D and E
H. A and B
J. D and B
K. C and B

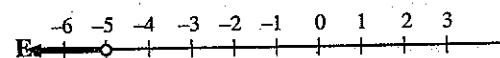
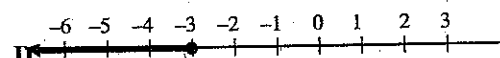
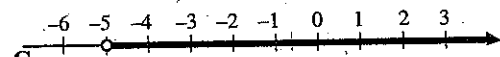
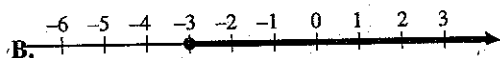
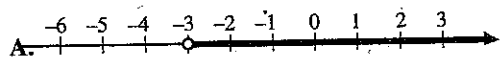


5. In the figure above, \overline{MO} is perpendicular to \overline{LN} , \overline{LO} is equal to 4, \overline{MO} is equal to \overline{ON} , and \overline{LM} is equal to 6. What is \overline{MN} ?

A. $2\sqrt{10}$
B. $3\sqrt{5}$
C. $4\sqrt{5}$
D. $3\sqrt{10}$
E. $6\sqrt{4}$

Graphing and Coordinate Geometry Drill

1. Which of the following represents the solution of the inequality $-3x - 6 > 9$?



2. What is the midpoint of the line segment whose endpoints are represented on the coordinate axis by the points (3,5) and (-4,3)?

F. (-2,-5)

G. $(-\frac{1}{2}, 4)$

H. (1,8)

J. $(4, -\frac{1}{2})$

K. (3,3)

3. What is the slope of the line represented by the equation $10x + 2x = y + 6$?

A. 10

B. 12

C. 14

D. 15

E. 16

4. What is the length of the line segment whose endpoints are represented on the coordinate axis by the points (-2,-1) and (1,3)?

F. 3

G. 4

H. 5

J. 6

K. 7

5. What is the slope of the line that contains the points (6,4) and (13,5)?

A. $-\frac{1}{8}$

B. $-\frac{1}{9}$

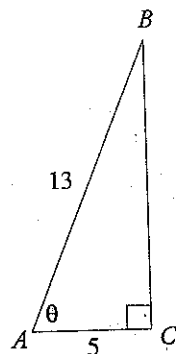
C. $\frac{1}{7}$

D. 1

E. 7

Trigonometry Drill

1. In $\triangle ABC$ below, the $\tan \theta$ equals



- A. $\frac{5}{12}$
- B. $\frac{12}{13}$
- C. $\frac{17}{12}$
- D. $\frac{12}{5}$
- E. 3

2. If the cotangent of an angle θ is 1, then the tangent of angle θ is

- F. -1
- G. 0
- H. 1
- J. 2
- K. 3

3. If $x + \sin^2 \theta + \cos^2 \theta = 4$, then $x = ?$

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

which sounds pretty good. Choice C— 2π —would be something more than 6. Already that's way too big. Choices D and E are even bigger. It sure looks like the answer has to be B—and it is.

Not many ACT students would be able to solve question 5 the textbook way. If you could, great! Solving the problem is *always* more reliable than eyeballing. But when you *don't* know how to solve a diagram problem, or if you think it would take forever to get an answer, eyeballing and eliminating answer choices sure beats wild guessing. Sometimes, as with question 5, you might even be able to narrow the choices down to the one that's probably correct.

Look
over

TYPICAL STORY PROBLEMS

We find that about one-third of the questions on the Math test are Story Problems. Though some Story Problems present unique situations that must be analyzed on the spot, others are just variations on familiar themes.

PERCENT PROBLEMS

In Percent Problems, you're usually given two numbers and asked to find a third. The key is to identify what you have and what you're looking for. In other words, identify the part, the percent, and the whole.

Put the numbers and the unknown into the general form:

$$\text{Part} = \text{Percent} \times \text{Whole}$$

Usually the part is associated with the word *is*, and the whole is associated with the word *of*.

Example

6. In a group of 250 students, 40 are seniors. What percentage of the group are seniors?
- F. 1.6%
 - G. 6.25%
 - H. 10%
 - J. 16%
 - K. 40%

The percent is what we're looking for ("What percentage . . ."); the whole is 250 ("... of the group . . ."); and the part is 40 ("... are seniors"). Plug these into the general formula:

$$\text{Part} = \text{Percent} \times \text{Whole}$$

$$40 = 250x$$

$$x = \frac{40}{250} = .16 = 16\%$$

The answer is J.

Many ACT Percent Problems concern percent change. To increase a number by a certain percent, calculate that percent of the original number and add it on. To decrease a number by a certain percent, calculate that percent of the original number and then subtract. For example, to answer the question, "What number is 30% greater than 80?" first find 30% of 80—that's 24—and add that on to 80: $80 + 24 = 104$.

The ACT has ways of complicating percent change problems. Especially tricky are problems with multiple changes, such as a percent increase followed by another percent increase or a percent increase followed by a percent decrease.

Example

7. If a positive number is increased by 70 percent, and then the result is decreased by 50 percent, which of the following accurately describes the net change?
- A. a 20 percent decrease
 - B. a 15 percent decrease
 - C. a 12 percent increase
 - D. a 20 percent increase
 - E. a 120 percent increase

To get a handle on this one, pick a number. Suppose the original number is 100. After a 70 percent increase, it rises to 170. That number, 170, is decreased by 50 percent, which means it's reduced by half to 85. The net change from 100 to 85 is a 15 percent decrease—choice B.

AVERAGE PROBLEMS

Instead of giving you a list of values to plug into the average formula, ACT Average Problems often put a slight spin on the question. They tell you the average of a group of terms and ask you to find the value of the missing term. Here's a classic example:

Example

8. To earn a B for the semester, Linda needs an average of at least 80 on the five tests. Her average for the first four test scores is 79. What is the minimum score she must get on the fifth test to earn a B for the semester?
- F. 80
 - G. 81
 - H. 82
 - J. 83
 - K. 84

EXPERT TUTOR TIP

Picking numbers is a good strategy when the answer choices are all percents. And 99 percent of the time the best number to pick—the easiest to work with—will be 100.

EXPERT TUTOR TIP

Back-solving is a fast way to work through Average Problems. Question 7 asks for the minimum score, so start with 80. Try plugging that in for the fifth test score.

EXPERT TUTOR TIP

The probability of what will happen is not affected by what already has happened. Whenever you flip a coin, the probability is $\frac{1}{2}$ that it will be heads. Even if you flip the coin and get heads ten times in a row, the probability is still $\frac{1}{2}$ on the 11th flip. Of course, the odds against 11 heads in a row are huge, but once the first ten flips are history they're no longer relevant.

The key to almost every Average Problem is to use the sum. Sums can be combined much more readily than averages. An average of 80 on five tests is more usefully thought of as a combined score of 400. To get a B for the semester, Linda's five test scores have to add up to 400 or more. The first four scores add up to $4 \times 79 = 316$. She needs another 84 to get that 316 up to 400. The answer is K.

WEIGHTED AVERAGE PROBLEMS

Another spin ACT test makers put on Average Problems is to give you an average for part of a group and an average for the rest of the group, and then ask for the combined average.

Example

9. In a class of 10 boys and 15 girls, the boys' average score on the final exam was 80 and the girls' average score was 90. What was the average score for the whole class?
- A. 83
B. 84
C. 85
D. 86
E. 87

Don't just average 80 and 90 to get 85. That would work only if the class had exactly the same number of girls as boys. In this case, there are more girls, so they carry more weight in the overall class average. In other words, the class average should be somewhat closer to 90 (the girls' average) than to 80 (the boys' average).

As usual with averages, the key is to use the sum. The average score for the whole class is the total of the 25 individual scores divided by 25. We don't have 25 scores to add up, but we can use the boys' average and the girls' average to get two subtotals.

If 10 boys average 80, then their 10 scores add up to 10×80 , or 800. If 15 girls average 90, then their 15 scores add up to 15×90 , or 1,350. Add the boys' total to the girls' total: $800 + 1,350 = 2,150$. That's the class total, which can be divided by 25 to get the class average: $\frac{2,150}{25} = 86$. The answer is D.

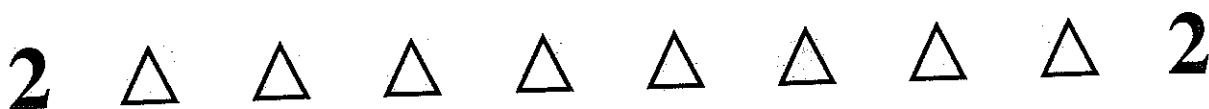
PROBABILITY PROBLEMS

Probabilities are part-to-whole ratios. The whole is the total number of possible outcomes. The part is the number of favorable outcomes. For example, if a drawer contains two black ties and five other ties and you want a black tie, the total number

of possible outcomes is seven (the total number of ties), and the number of favorable outcomes is two (the number of black ties). The probability of choosing a black tie at random is $\frac{2}{7}$.

WHAT TO DO NEXT

Because more than half the Math questions on the ACT involve algebra, it's a good idea to solidify your understanding of the basics before test day. Focus on #52–70 in 100 Key Math Concepts for the ACT. Keep things in perspective. **Geometry questions are important, too, but algebra questions are more important.**

**MATHEMATICS TEST**

60 Minutes—60 Questions

DIRECTIONS: Solve each of the problems in the time allowed, then fill in the corresponding bubble on your answer sheet. Do not spend too much time on any one problem; skip the more difficult problems and go back to them later.

You may use a calculator on this test. For this test you should assume that figures are NOT necessarily drawn to scale, that all geometric figures lie in a plane, and that the word line is used to indicate a straight line.

1. Which of the following lists all the positive factors of 32?
- A. 1, 32
 - B. 2, 16
 - C. 2, 4, 8, 16
 - D. 2, 4, 8, 16, 32
 - E. 1, 2, 4, 8, 16, 32

2. All CDs are equally priced. If 8 CDs cost \$76.00, what is the cost of 1 CD?
- F. \$0.10
 - G. \$2.05
 - H. \$7.60
 - J. \$9.50
 - K. \$10.50

3. $2x^2 \times 3x^2y^2 \times 5x^2y$ is equivalent to:
- A. $30x^8y^3$
 - B. $30x^8y^2$
 - C. $30x^6y^3$
 - D. $11x^8y^3$
 - E. $11x^6y^2$

4. What is the value of the expression $10(100x - 10,000) + 100$ when $x = 250$?
- F. 2,500
 - G. 150,100
 - H. 160,000
 - J. 210,000
 - K. 300,100

5. $4a^3 \times 5a^8 = ?$
- A. $9a^5$
 - B. $9a^{11}$
 - C. $9a^{24}$
 - D. $20a^{11}$
 - E. $20a^{24}$

DO YOUR FIGURING HERE.**GO ON TO THE NEXT PAGE**

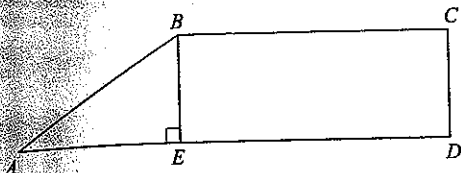
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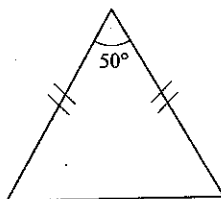
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6. In the figure shown below, $AD = 16$, $ED = 11$, and AE is congruent to CD . What is the length of AB ?

DO YOUR FIGURING HERE.



- F. 5
G. $5\sqrt{2}$
H. 6
J. $11\sqrt{2}$
K. 25
7. Which of the following numbers is the least in value?
A. 0.02×10^4
B. 0.2×10^3
C. 2.0×10^{-2}
D. 20.0×10^2
E. 0.002×10^5
8. The isosceles triangle below has one angle measure as shown. What is the measure of each of the other angles?



- F. 30°
G. 45°
H. 50°
J. 65°
K. 130°
9. The sum of the real numbers a and b is 13. Their difference is 5. What is the value of ab ?
A. 5
B. 8
C. 18
D. 36
E. 65
10. 37 is what percent of 144, to the nearest percent?
F. 26%
G. 37%
H. 44%
J. 74%
K. 107%

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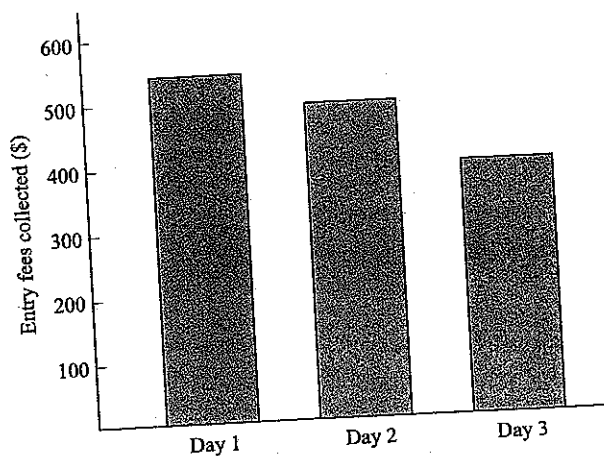


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Use the following information to answer Questions 11–12.

DO YOUR FIGURING HERE.

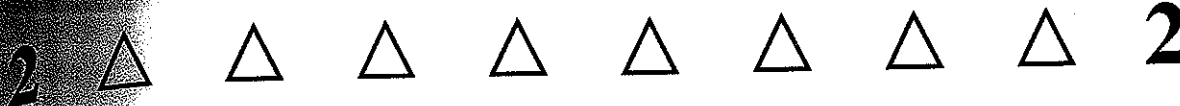
The Moondance Riding Academy held its annual horse show for 3 days. The total amount collected in entry fees for the 3 days was \$1,450. The amount collected, in dollars, is shown for each of the 3 days in the bar graph below:



11. Approximately what percent of the money collected from entry fees over the 3 days was collected on Day 2?
- A. 29%
 - B. 34%
 - C. 38%
 - D. 66%
 - E. 90%
12. The mean amount collected per day during the 3-day period is what, to the nearest dollar?
- F. \$300
 - G. \$483
 - H. \$577
 - J. \$1,450
 - K. \$4,350

13. For all n , $(3n + 5)^2 = ?$
- A. $6n^2 + 15n + 10$
 - B. $6n^2 + 30n + 25$
 - C. $9n^2 + 6n + 10$
 - D. $9n^2 + 15n + 25$
 - E. $9n^2 + 30n + 25$

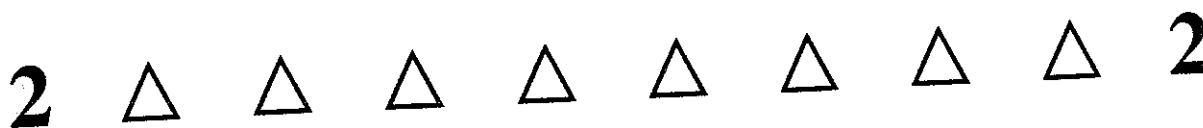
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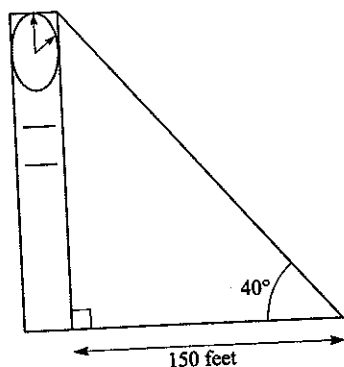
14. A certain brand of cereal costs \$3.25 per box before sales tax is added. When you buy 5 or more boxes of this cereal you receive 1 additional box for free. What is the average cost per box of cereal for 6 boxes before sales tax is added?
- F. \$2.17
G. \$2.71
H. \$2.80
J. \$3.25
K. \$3.79
15. Rana and Tom own a pizza shop, which offers 3 kinds of cheese, 4 kinds of meat toppings, and 5 kinds of vegetable toppings. Each type of pizza on the menu has a combination of exactly 3 ingredients: 1 cheese, 1 meat, and 1 vegetable. How many types of pizzas are possible?
- A. 12
B. 24
C. 36
D. 50
E. 60
16. On the real number line, what is the midpoint of -3 and 11 ?
- F. -5
G. 0
H. 4
J. 7
K. 14
17. Which real number satisfies $(2^n)(8) = 16^3$?
- A. 3
B. 4
C. 6
D. 9
E. 12
18. If $f(x) = -3x^2 - 8$, then $f(-4) = ?$
- F. -56
G. -40
H. 8
J. 24
K. 40

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DO YOUR FIGURING HERE.

19. A clock tower casts a 150-foot shadow on level ground, as shown below. The angle of elevation from the tip of the shadow to the top of the tower is 40° . To the nearest tenth of a foot, what is the height of the clock tower?



(Note: $\cos 40^\circ = \sin 50^\circ \approx 0.77$

$\cos 50^\circ = \sin 40^\circ \approx 0.64$

$\tan 50^\circ \approx 1.19$

$\tan 40^\circ \approx 0.84$)

- A. 194.8
 - B. 178.5
 - C. 150.0
 - D. 126.0
 - E. 115.5
20. If $4(x - 2) + 5x = 3(x + 3) - 11$, then $x = ?$
- F. -3
 - G. -1
 - H. 0
 - J. 1
 - K. 2
21. What is the least common multiple of 40, 70, and 60?
- A. 240
 - B. 420
 - C. 840
 - D. 1,680
 - E. 168,000
22. If $4\frac{2}{5} = a - 1\frac{2}{3}$, then $a = ?$
- F. $\frac{95}{15}$
 - G. $\frac{91}{15}$
 - H. $\frac{41}{15}$
 - J. $\frac{27}{8}$
 - K. $\frac{17}{8}$

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DO YOUR FIGURING HERE.

23. A system of linear equations is shown below.

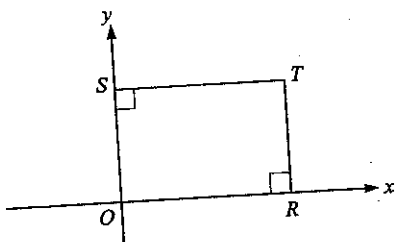
$$4y - 2x = 8$$

$$4y + 2x = 8$$

Which of the following describes the graph of this system of linear equations in the standard (x, y) coordinate plane?

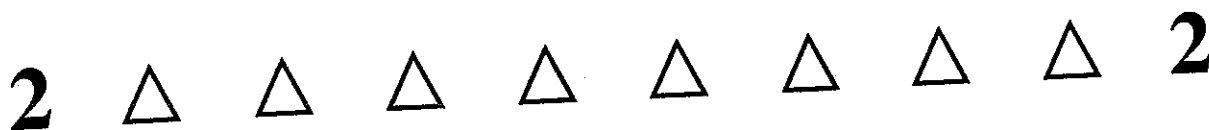
- A. A single line with positive slope
 - B. A single line with negative slope
 - C. Two distinct intersecting lines
 - D. Two parallel lines with positive slope
 - E. Two parallel lines with negative slope
24. A house painter charges \$24.00 per hour for a painting job that requires more than 5 hours to complete. For any job requiring 5 hours or less, the house painter charges a flat fee of \$100. If n represents the number of hours the job requires, which of the following expressions gives the charge, in dollars, for a job requiring more than 5 hours to complete?
- F. 124.0
 - G. $-24n + 100$
 - H. $24n - 100$
 - J. $24n$
 - K. $24n + 100$
25. The average (arithmetic mean) of a and b is 6 and the average of a , b , and c is 11. What is the value of c ?
- A. 21
 - B. 17
 - C. 13
 - D. 8
 - E. 5

26. In the figure below, $OS = ST$ and the coordinates of T are $(k, 5)$. What is the value of k ?



- F. -5
- G. -3
- H. -2
- J. 0
- K. 5

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DO YOUR FIGURING HERE.

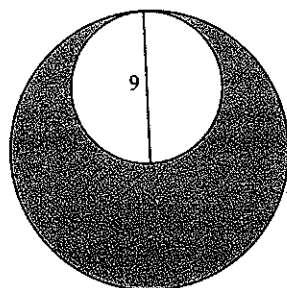
27. At a summer camp, one boy and one girl will be selected to lead the weekly activities. If there are 130 boys and 145 girls at the camp, how many different 2-person combinations of 1 boy and 1 girl are possible?

A. 15
B. 275
C. 550
D. 9,425
E. 18,850

28. If 3 times a number x is added to 12, the result is negative. Which of the following gives the possible value(s) for x ?

F. All $x > 4$
G. All $x < -4$
H. 36 only
J. 4 only
K. 0 only

29. The figure below shows 2 tangent circles such that the 9-inch diameter of the smaller circle is equal to the radius of the larger circle. What is the approximate area, in square inches, of the shaded region?



A. 28.27
B. 56.55
C. 63.62
D. 190.76
E. 254.47

30. $(x^3 + 2x^2 + 3x - 2) - (2x^3 - x^2 - 4)$ is equivalent to:
- F. $-x^3 + x^2 + 3x - 6$
G. $-x^3 + 3x^2 + 3x + 2$
H. $2x^3 - 2x^2 + 3x - 2$
J. $2x^6 + x^4 + 3x - 6$
K. $2x^6 + 3x^4 + 3x + 2$

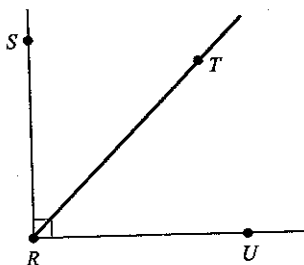
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DO YOUR FIGURING HERE.

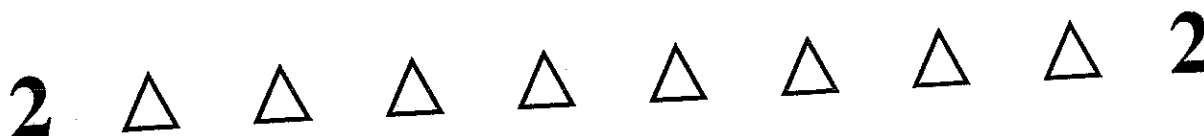
x	0	1	2	3
$f(x)$	-6	-5	-2	3

31. The table above gives values of the quadratic function f for selected values of x . Which of the following defines the quadratic function f ?
- A. $f(x) = x^2 - 6$
 - B. $f(x) = x^2 + 6$
 - C. $f(x) = 2x^2 - 10$
 - D. $f(x) = 2x^2 - 6$
 - E. $f(x) = 2x^2 - 7$
32. What is the median of the following 6 test scores?
- 64, 72, 85, 80, 72, 89
- F. 64
 - G. 72
 - H. 76
 - J. 77
 - K. 82.5
33. For all numbers x and y , let the operation \boxtimes be defined as $x \boxtimes y = 2xy - 4x$. If a and b are positive integers, which of the following can be equal to zero?
- I. $a \boxtimes b$
 - II. $(a - b) \boxtimes b$
 - III. $b \boxtimes (a - b)$
- A. I only
 - B. II only
 - C. III only
 - D. I and II only
 - E. I, II, and III
34. In the figure shown below, the measure of $\angle SRT$ is $(x + 15)^\circ$ and the measure of $\angle SRU$ is 90° . What is the measure of $\angle TRU$?



- F. $(105 + x)^\circ$
- G. $(105 - x)^\circ$
- H. $(75 + x)^\circ$
- J. $(75 - x)^\circ$
- K. $(x - 75)^\circ$

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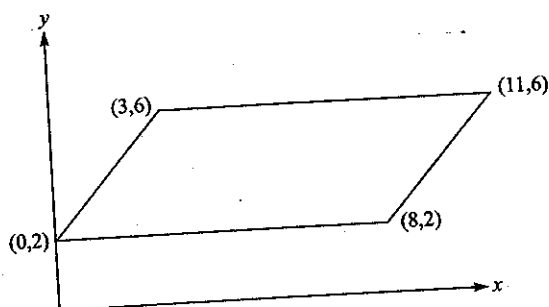


DO YOUR FIGURING HERE.

35. $(6a - 12) - (4a + 4) = ?$

- A. $2(a + 2)$
- B. $2(a + 4)$
- C. $2(a - 2)$
- D. $2(a - 4)$
- E. $2(a - 8)$

36. In the standard (x, y) coordinate plane below, the points $(0,2)$, $(8,2)$, $(3,6)$, and $(11,6)$ are the vertices of a parallelogram. What is the area, in square units, of the parallelogram?



- F. $6\sqrt{2}$
- G. 16
- H. 32
- J. 56
- K. 88

37. Which of the following equations expresses z in terms of x for all real numbers x , y , and z , such that $x^5 = y$ and $y^3 = z$?

- A. $z = x$
- B. $z = \frac{3}{5}x$
- C. $z = 3x^5$
- D. $z = x^8$
- E. $z = x^{15}$

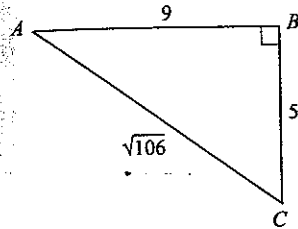
38. Which of the following statements is NOT true about the geometric sequence $36, 18, 9, \dots$?

- F. The fourth term is 4.5.
- G. The sum of the first five terms is 69.75.
- H. Each consecutive term is $\frac{1}{2}$ of the previous term.
- J. Each consecutive term is evenly divisible by 3.
- K. The common ratio of consecutive terms is 2:1.

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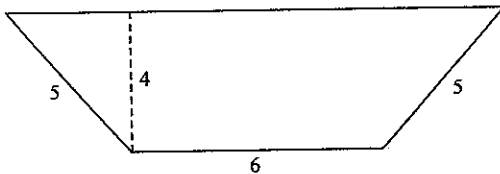
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39. For right triangle ABC with dimensions in centimeters as given below, what is $\tan C$?



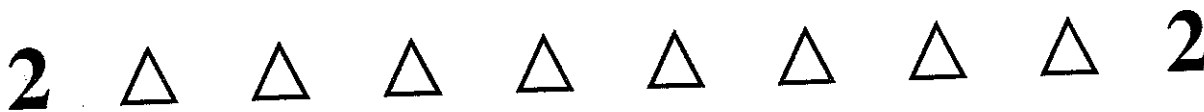
DO YOUR FIGURING HERE.

- A. $\frac{5}{9}$
B. $\frac{5}{\sqrt{106}}$
C. $\frac{9}{\sqrt{106}}$
D. $\frac{\sqrt{106}}{9}$
E. $\frac{9}{5}$
40. The area of a trapezoid is found by using the equation $\frac{1}{2}h(b_1 + b_2)$, where h is the height and b_1 and b_2 are the lengths of the bases. What is the area of the trapezoid shown below?



- F. 18
G. 20
H. 24
J. 30
K. 36
41. The diagonal of a rectangular garden is 15 feet, and one side is 9 feet. What is the perimeter of the garden?
- A. 135
B. 108
C. 68
D. 48
E. 42

GO ON TO THE NEXT PAGE.



DO YOUR FIGURING HERE.

42. $\left(\frac{1}{3}a - b\right)^2 = ?$

F. $\frac{1}{9}a^2 + b^2$

G. $\frac{1}{9}a^2 - \frac{2}{3}ab + b^2$

H. $\frac{1}{3}a^2 - \frac{2}{3}ab + b^2$

J. $a^2 + b^2$

K. $a^2 - \frac{1}{3}ab + b^2$

43. Which of the following inequalities defines the solution set for the inequality $23 - 6x \geq 5$?

A. $x \geq -3$

B. $x \geq 3$

C. $x \geq 6$

D. $x \leq 3$

E. $x \leq -6$

44. What is the approximate distance between the points $(4, -3)$ and $(-6, 5)$ in the standard (x, y) coordinate plane?

F. 8.92

G. 12.81

H. 16.97

J. 17.95

K. 19.22

45. The ratio of x to z is 3 to 5, and the ratio of y to z is 1 to 5. What is the ratio of x to y ?

A. 5:3

B. 5:1

C. 3:1

D. 1:3

E. 1:1

46. If $\tan \alpha = \frac{x}{y}$, $x > 0$, $y > 0$, and $0 < \alpha < \frac{\pi}{2}$, then what is $\cos \alpha$?

F. $\frac{\sqrt{x^2 + y^2}}{y}$

G. $\frac{y}{\sqrt{x^2 + y^2}}$

H. $\frac{x}{\sqrt{x^2 + y^2}}$

J. $\frac{y}{x}$

K. $\frac{x}{y}$

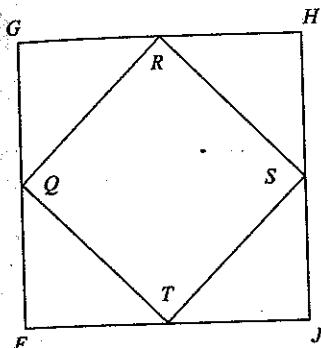
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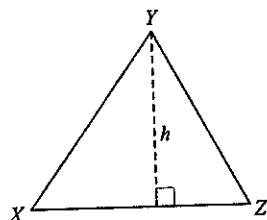
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47. In the figure below, $FGHJ$ is a square and Q , R , S , and T are the midpoints of its sides. If $\overline{GH} = 10$ inches, what is the area of $QRST$, in inches?



- A. 100
- B. 50
- C. 25
- D. 20
- E. $5\sqrt{2}$

48. In $\triangle XYZ$ below, \overline{XZ} is $\frac{7}{8}$ of h , the length of the altitude. What is the area of $\triangle XYZ$ in terms of h ?



- F. $\frac{7h}{8}$
- G. $\frac{7h^2}{8}$
- H. $\frac{7h}{16}$
- J. $\frac{7h^2}{16}$
- K. $\frac{7h^2}{12}$

49. On Friday, a computer was priced at \$800. On the following Wednesday, the price was reduced by 15%. On the following Friday, the price was further reduced by 20%. What percent of the original price was the final price?
- A. 82.5
 - B. 68
 - C. 65
 - D. 35
 - E. 32

DO YOUR FIGURING HERE.

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2



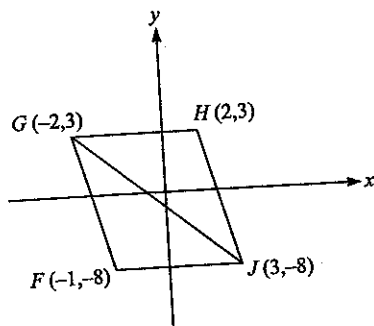
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DO YOUR FIGURING HERE.

50. If $ghjk = 24$ and $ghkl = 0$, which of the following must be true?

F. $g > 0$
 G. $h > 0$
 H. $j = 0$
 J. $k = 0$
 K. $l = 0$

51. Given the vertices of parallelogram $FGHJ$ in the standard (x, y) coordinate plane below, what is the area of triangle GHJ , in square units?



A. 11
 B. 15
 C. 22
 D. 44
 E. 88

52. If X , Y , and Z are real numbers, and $XYZ = 1$, then which of the following conditions must be true?

F. $XZ = \frac{1}{Y}$

G. X , Y , and $Z > 0$

H. Either $X = 1$, $Y = 1$, or $Z = 1$

J. Either $X = 0$, $Y = 0$, or $Z = 0$

K. Either $X < 1$, $Y < 1$, or $Z < 1$

53. In the standard (x, y) coordinate plane, the y -intercept of the line $6x + 2y = 14$ is?

A. -6
 B. -3
 C. 2
 D. 7
 E. 14

54. The average of a set of six integers is 38. When a seventh number is included in the set, the average of the set increases to 47. What is the seventh number?

F. 38
 G. 47
 H. 101
 J. 228
 K. 329

GO ON TO THE NEXT PAGE

2



2

DO YOUR FIGURING HERE.

55. The area of a rectangular kitchen is 80 square feet. If the length of the floor is 4 feet less than four times the width, what is the width of the floor in feet?

A. 4
B. 5
C. 8
D. 16
E. 17

56. For every cent increase in price of a pound of apples, the grocery store sells 25 fewer pounds per day. The grocery store normally sells 800 pounds of apples per day at \$1.09 per pound. Which of the following expressions represents the number of pounds of apples sold per day if the cost is increased by $3x$ cents per pound of apples?

F. $(1.09 + 3x)(800 - 75x)$
G. $800 - 25x$
H. $800 - 75(1.09)x$
J. $800 + 75x$
K. $800 - 75x$

57. Jason has been hired to build a circular wading pool in his neighbor's backyard. The rectangular backyard measures 60 feet wide by 50 feet long. Jason's neighbors want the pool to be as large as possible, with the edge of the pool at least 8 feet from the edge of the backyard all around. How long should the radius of the pool be, in feet?

A. 8
B. 17
C. 22
D. 34
E. 44

58. If $f(x) = x^2 + 3$, then $f(x + y) = ?$

F. $x^2 + 2xy + y^2 + 3$
G. $x^2 + 2xy + y^2$
H. $x^2 + 2xy + 3$
J. $x^2 + 3 + y$
K. $x^2 + y^2$

GO ON TO THE NEXT PAGE.

2 \triangle \triangle \triangle \triangle \triangle \triangle \triangle \triangle 2

DO YOUR FIGURING HERE.

59. In a game, 84 marbles numbered 00 through 83 are placed in a box. A player draws 1 marble at random from the box. Without replacing the first marble, the player draws a second marble at random. If both marbles drawn have the same tens digit (that is, both marbles are numbered between 00 and 09, or 10 and 19, or 20 and 29, etc.), the player is a winner. If the first marble Dave draws is numbered 23, what is the probability that Dave will be a winner on the next draw?

- A. $\frac{9}{84}$
B. $\frac{74}{83}$
C. $\frac{9}{83}$
D. $\frac{75}{84}$
E. $\frac{10}{83}$

60. What is the smallest possible value for the product of 2 real numbers that differ by 6?

- F. -9
G. -8
H. -5
J. 0
K. 7

END OF THE MATHEMATICS TEST.
STOP! IF YOU HAVE TIME LEFT OVER, CHECK YOUR WORK ON THIS SECTION ONLY.

Mathematics Test

1. E	21. C	41. E
2. J	22. G	42. G
3. C	23. C	43. D
4. G	24. J	44. G
5. D	25. A	45. C
6. G	26. K	46. G
7. C	27. E	47. B
8. J	28. G	48. J
9. D	29. D	49. B
10. F	30. G	50. K
11. B	31. A	51. C
12. G	32. H	52. F
13. E	33. E	53. D
14. G	34. J	54. H
15. E	35. E	55. B
16. H	36. H	56. K
17. D	37. E	57. B
18. F	38. J	58. F
19. D	39. E	59. C
20. J	40. K	60. F